```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

from sklearn.datasets import load_breast_cancer
from sklearn.model_selection import train_test_split, GridSearchCV, cross_val_score
from sklearn.preprocessing import StandardScaler
from sklearn.svm import SVC
from sklearn.metrics import accuracy_score, confusion_matrix, classification_report
```

```
data = load_breast_cancer()
X = pd.DataFrame(data.data, columns=data.feature_names)
y = pd.Series(data.target)

print("Shape:", X.shape)
X.head()
```

```
Shape: (569, 30)
```

	mean radius	mean texture	mean perimeter	mean area	mean smoothness	mean compactness	mean concavity	mean concave points	mean symmetry	mean fractal dimension	...	worst radius	worst texture
0	17.99	10.38	122.80	1001.0	0.11840	0.27760	0.3001	0.14710	0.2419	0.07871	...	25.38	17.33
1	20.57	17.77	132.90	1326.0	0.08474	0.07864	0.0869	0.07017	0.1812	0.05667	...	24.99	23.41
2	19.69	21.25	130.00	1203.0	0.10960	0.15990	0.1974	0.12790	0.2069	0.05999	...	23.57	25.53
3	11.42	20.38	77.58	386.1	0.14250	0.28390	0.2414	0.10520	0.2597	0.09744	...	14.91	26.50
4	20.29	14.34	135.10	1297.0	0.10030	0.13280	0.1980	0.10430	0.1809	0.05883	...	22.54	16.67

5 rows × 30 columns

```
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)
```

```
X_train, X_test, y_train, y_test = train_test_split(
    X_scaled, y, test_size=0.2, random_state=42
)
```

```
svm_linear = SVC(kernel='linear')
svm_linear.fit(X_train, y_train)

y_pred_linear = svm_linear.predict(X_test)

print("Linear Kernel Accuracy:", accuracy_score(y_test, y_pred_linear))
```

```
Linear Kernel Accuracy: 0.956140350877193
```

```
svm_rbf = SVC(kernel='rbf')
svm_rbf.fit(X_train, y_train)

y_pred_rbf = svm_rbf.predict(X_test)

print("RBF Kernel Accuracy:", accuracy_score(y_test, y_pred_rbf))
```

```
RBF Kernel Accuracy: 0.9736842105263158
```

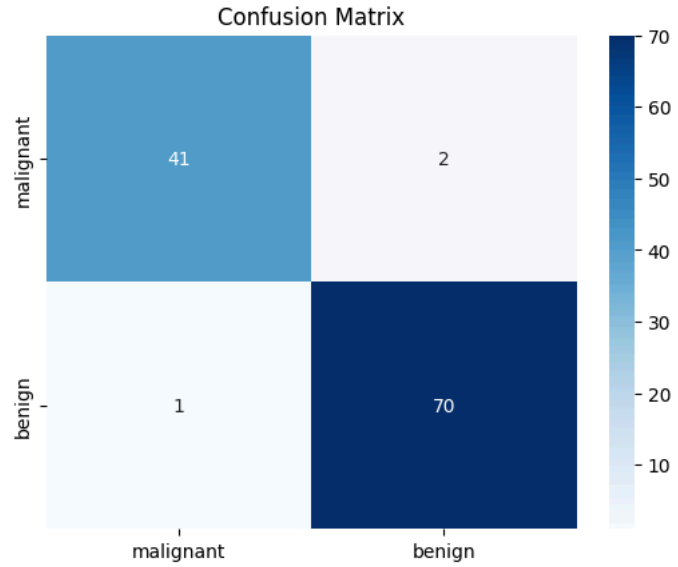
```
params = {
    'C': [0.1, 1, 10, 100],
    'gamma': ['scale', 0.1, 0.01, 0.001]
}

grid = GridSearchCV(SVC(kernel='rbf'), params, cv=5)
grid.fit(X_train, y_train)

print("Best Parameters:", grid.best_params_)
print("Best Score:", grid.best_score_)
```

```
Best Parameters: {'C': 1, 'gamma': 'scale'}
Best Score: 0.9736263736263737
```

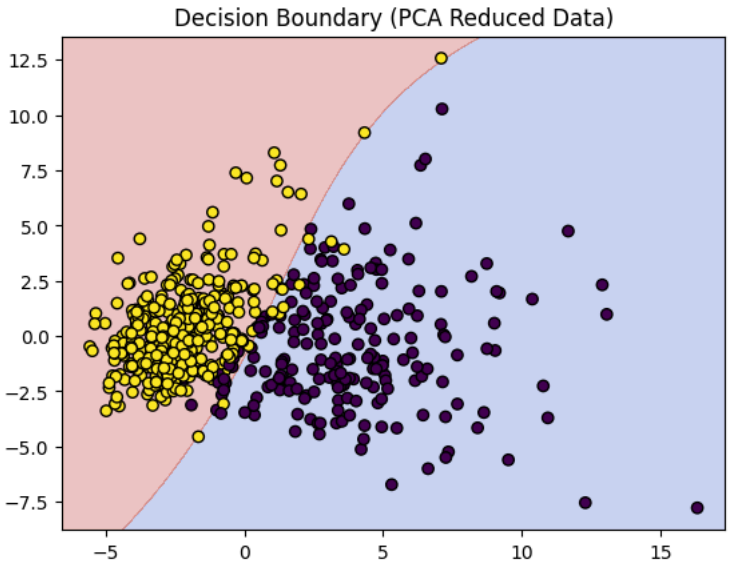
```
best_model = grid.best_estimator_
y_pred_best = best_model.predict(X_test)

print("\nBest Model Accuracy:", accuracy_score(y_test, y_pred_best))
print("\nClassification Report:\n", classification_report(y_test, y_pred_best))
```

```
Best Model Accuracy: 0.9736842105263158

Classification Report:
              precision    recall  f1-score   support

           0       0.98      0.95      0.96        43
           1       0.97      0.99      0.98        71

    accuracy                           0.97       114
   macro avg       0.97      0.97      0.97       114
weighted avg       0.97      0.97      0.97       114
```

```
cm = confusion_matrix(y_test, y_pred_best)

sns.heatmap(cm, annot=True, fmt="d", cmap="Blues",
            xticklabels=data.target_names, yticklabels=data.target_names)

plt.title("Confusion Matrix")
plt.show()
```




```
from sklearn.decomposition import PCA

pca = PCA(n_components=2)
X_2d = pca.fit_transform(X_scaled)

model_2d = SVC(kernel='rbf', C=1, gamma=0.01)
model_2d.fit(X_2d, y)

# plot
h = .02
x_min, x_max = X_2d[:,0].min() - 1, X_2d[:,0].max() + 1
y_min, y_max = X_2d[:,1].min() - 1, X_2d[:,1].max() + 1
xx, yy = np.meshgrid(np.arange(x_min, x_max, h),
                     np.arange(y_min, y_max, h))

Z = model_2d.predict(np.c_[xx.ravel(), yy.ravel()]).reshape(xx.shape)

plt.contourf(xx, yy, Z, cmap='coolwarm', alpha=0.3)
plt.scatter(X_2d[:,0], X_2d[:,1], c=y, edgecolors='k')
plt.title("Decision Boundary (PCA Reduced Data)")
plt.show()
```


Decision Boundary (PCA Reduced Data)
12.5
10.0
7.5
5.0
2.5
0.0
−2.5
−5.0
−7.5
−5
0
5
10
15